Water for the World

Estimating Sewage or Washwater Flows

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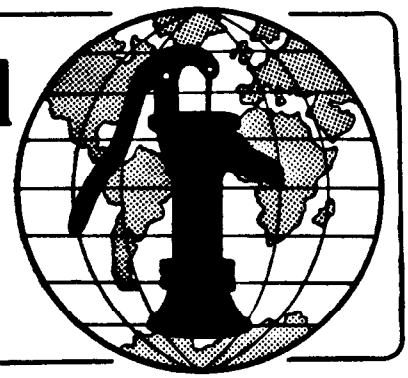

Estimating how much sewage or washwater will flow from a home, communal latrine, or public building is an essential part of planning and designing sewage or washwater disposal systems. Making this estimate involves identifying the source or sources of the flow, then determining the probable daily flow by one or more of five methods. The result is a flow estimate expressed in liters per day or gallons per day.

Sewage or washwater flow from a single building or an entire community cannot, and need not, be calculated to the exact liter. There are too many variables involved. Among them are growth in the size of a community; seasonal variation in the number of people living in a community; and changes in the number of people living in each household. There are several methods that, when used carefully, provide estimates accurate enough to design on-site or community sewage or washwater disposal systems. The five methods are on-site measurement; on-site estimating; water meter estimates; community water use data; and survey estimating.

This technical note describes these five methods of estimating sewage or washwater flows. Read the entire technical note before making estimates.

Materials Needed

Container with a known capacity
Measuring tape or ruler

Useful Definitions

FLOW - The amount of sewage or washwater that moves through a pipe in a given time, usually expressed as liters per second.

GROUNDWATER - Water stored below the ground's surface. Groundwater levels affect seepage into sewer pipes and may increase flow.

SEWAGE - All washwater, excreta, and water used to flush excreta that flows from a building or buildings, through a sewer pipe, and into a septic tank, cesspool, or stabilization pond.

STANDPIPE - A pressurized water outlet or faucet located outdoors.

WASHWATER - Water that has been used for bathing or washing clothes, dishes, or kitchen utensils.

On-site Measurement

If water is hand-carried into the building, multiply the capacity of the container by the number of trips per day with the filled container to calculate the daily flow.

capacity of container x trips per day = daily flow

If water is piped into the building or home, measure the capacity of each sink, wash basin, and water seal latrine and multiply each capacity by the number of times each fixture is filled during the day. By "filled," we

mean to the level in the container that is normally reached for washing dishes or clothes, or for bathing. Do not measure to the brim as that is not the level normally used. Add the quantities to find the total daily flow.

capacity of wash basin x use per day = volume a

capacity of water seal latrine x use per day = volume b

capacity of sink x use per day = volume c

capacity of other (water closet, bathtub) x use per day = volume d

Volumes a + b + c + d = daily flow

(NOTE: For a more accurate measurement, calculate the daily flow for three consecutive days and divide the total by three.)

To calculate the capacity of a wash basin, tub, latrine, sink, or water closet using a container of known capacity, fill the container with water to the level of use and pour it into the fixture. Repeat until the fixture is full or until the pour-flush latrine has flushed. Multiply the number of times the container was used by the capacity of the container to find the capacity of the fixture.

number of uses x capacity of container = capacity of fixture.

If you do not know the capacity of the container or fixture you can calculate it with a measuring tape. First, measure the length, width, and depth of the container in millimeters. Then, multiply the length times the width times the depth to calculate the capacity in cubic millimeters. Finally, multiply the cubic millimeters by 0.00001 to find the capacity in liters.

length x width x depth x 0.00001 = liters

For a cylindrical container, such as a bucket, first measure the diameter at the top in millimeters and divide by two. Second, multiply that number times itself. Third, multiply the result of the second step by 3.1. Fourth, multiply the result of the third step by the depth of the container to find the capacity in cubic millimeters. Finally, multiply cubic millimeters by 0.00001 to find capacity in liters.

$\frac{\text{diameter}}{2} \times \frac{\text{diameter}}{2} \times 3.1 \times \text{depth} \times 0.00001 = \text{liters}$

If a shower is used, calculate the amount of washwater per shower by filling a container of known capacity with water from the shower head and timing how many minutes it takes. Divide that number of minutes into the number of minutes it takes a person to shower; multiply the result by the capacity of the container. If the length of the shower is not known, use five minutes as a reasonable estimate. It may be necessary to take into account the number of showers per day, a figure that varies from person to person and country to country.

$\frac{\text{minutes per shower}}{\text{minutes to fill container}} \times \text{capacity of container} = \text{amount used per shower.}$

Example. The daily flow of washwater from a family dwelling must be estimated. The dwelling has a kitchen sink, used to wash dishes and pots, and a wash basin, used to wash clothes. The size and frequency of use of each fixture is:

Sink: 8 liters, filled three times each day;

Wash basin: 30 liters, filled once each day.

The daily flow = 8 liters x 3 = 24 liters + 30 liters x 1 = 30 liters. The daily flow = 54 liters per day.

On-site Estimating

This method is similar to on-site measurement, except that the following tables are used to estimate quantities instead of measuring the capacity of each fixture and documenting the frequency of use. While this method is simpler to use than on-site measurement, it is not as accurate.

Table 1. Water from Standpipe

Country	Water Use Per Person Per Day (in Liters)*
Africa	15-35
Southeast Asia	30-70
Western Pacific	30-95
Eastern Mediterranean	40-85
Algeria-Morocco-Turkey	20-65
Latin America/Caribbean	70-190

*Averages are for areas where water is handcarried from standpipes no more than 200m distant.

For example, suppose water for a six-person dwelling in Southeast Asia is hand-carried from a standpipe 30m distant. Using Table 1 the daily flow = 70 liters x 6 = 420 liters per day.

Table 2. Sewage or Washwater Per Fixture

Fixture	Amount Per Use (in Liters)
Pour-flush Latrine	1-3
Tank-type Flush Toilet	13-23
Wash Basin	5
Shower	95-120
Kitchen Sink	15-18
Laundry Sink (wash/ rinse)	150-190

If there is doubt as to which number to use in Table 2, use the higher number. When using Table 2, first determine the number of times each fixture is used per day. For example, suppose the pour-flush latrine is used 18 times, the wash basin six, the kitchen sink three, and the laundry sink once. Then the daily flow is:

Pour-flush latrine = 3 liters x 18 = 54 liters, plus:

Wash basin = 5 liters x 6 = 30 liters, plus:

Kitchen sink = 18 liters x 3 = 54 liters, plus:

Laundry sink = 190 liters x 1 = 190 liters, equals:

The daily flow = 328 liters per day.

Table 3. Sewage Flow by Building Type

Building Type	Amount Per Person Per day (in Liters)
Private Home (full plumbing)	150-300
Public Buildings (toilets/sinks)	11-38
Communal Latrines	40

If there is doubt as to which number to use in Table 3, use the higher number. When using Table 3, first determine the type of building and the number of persons living in or using the building. For example, suppose a school has 40 pupils and three teachers for a total of 43 persons.

Then the daily flow = 43 x 38 liters = 1634 liters per day.

Water Meter Estimates

If water is piped to a building equipped with a water meter, take two meter readings one week apart, subtract the first reading from the second, and divide by seven to estimate the daily flow. The meter readings should be made on days of typical usage, not holidays or other times of slack use.

$$\frac{\text{second reading - first reading}}{7} = \text{daily flow}$$

For example, suppose the first reading is 001587 and the second reading, one week later, is 003771.

$$\text{Then the daily flow} = \frac{003771 - 001587}{7}$$
$$= \frac{2184}{7}$$
$$= 312 \text{ liters per day}$$

If some of the water piped to the building is used for watering a garden or farm animals, this amount must be estimated and subtracted from the water meter estimate since this water will not enter the sewage disposal system. To estimate the amount used for garden or animal watering, use the on-site measurement method. If a hose is used for watering, estimate the flow by the same means described for a shower.

meter estimate - watering estimate = daily flow.

For example, suppose that the water meter estimate shows the daily flow to be 400 liters per day, but 100 liters per day is used for watering.

The daily flow = 400 liters - 100 liters = 300 liters per day.

(NOTE: If a single disposal system is to serve more than one building, add the daily flow of each building to find the total daily flow. Flow from building A + flow from B + flow from C = total daily flow.)

Community Water Use Data

This method is appropriate only for planning community sewage disposal systems. It can be used if the community is served by a water department or a water distribution company. The records kept by the department or company are used to estimate the daily flow for the entire community. Water that will not enter the sewage disposal system, such as water for crops, community fire control, and street flushing, must be subtracted from the department's or company's daily flow estimate. The flows should be totalled for 30 consecutive days and the total divided by 30 to estimate the daily flow.

$$\frac{\text{30-day community water use} - \text{30-day other use}}{30} = \text{community daily flow}$$

For example, the water company's records show that for a community of 100 buildings the total 30-day output of water is 724000 liters. A portion of this water is diverted to a community agricultural field and a water meter at the diversion point shows that the 30-day total for watering crops is 120000 liters. The only other major use of water is street flushing; once each month a 4000-liter truck is filled and used to flush the main streets.

The 30-day flow = 724000 liters - 120000 liters - 4000 liters = 600000 liters.

$$\text{The daily flow} = \frac{600000 \text{ liters}}{30}$$
$$= 20000 \text{ liters per day.}$$

This is the figure to use in designing the community disposal system.

Survey Estimating

This method involves collecting data from every dwelling, building, and communal latrine in the community. It is time-consuming but may be the only practical way to estimate sewage flows in an area where water meters and water company data are not available or are not trustworthy.

If the community is too large to make house-to-house data collection practical, it may be necessary to survey one building in five, or one in ten. This must be a representative sampling, including both large and small dwellngs, dwellings both with and without piped water, and both public buildings and private homes.

The data may be obtained by any combination of the first three methods discussed. For example, some buildings may have water meters; people in buildings without meters may provide water use estimates; residents may provide only general information; they may hand-carry water to the dwelling and be able to report how much they carry.

After each dwelling, building, and communal latrine in the community has been surveyed, tabulate the results for each and add them together to find the total daily flow of sewage for the community.

Example. Suppose there are five dwellings and one public building in the community, and the following data is obtained:

Building 1 is a public building with piped water and a water meter, and the flow estimate from meter readings is 1000 liters per day. This number will be written on Line 1 of Worksheet A.

Building 2 is a residence with piped water and no meter but the head of the household provided a daily flow estimate of 450 liters. (Worksheet A, Line 2.)

Building 3 is a residence with piped water and no meter. The residents could not provide a daily flow estimate, but they did estimate the number of times each fixture in the house was used each day: pour-flush latrine, 18 times; wash basin, 12 times; shower, 3 times; kitchen sink, 3 times; and laundry sink, once per day. These numbers are written in on the proper lines (between Lines 2 and 3). Calculations are made on a separate sheet of paper using Table 2. The total flow is calculated to be 718 liters per day. (Worksheet A, Line 3.)

Building 4 is a residence with piped water, no meter, and the residents provided no information. There are two persons living in the house. Write this number on the proper line (between Lines 3 and 4) and use Table 3 to estimate the daily flow: 600 liters. (Worksheet A, Line 4.)

Building 5 is a residence and water is hand-carried from a standpipe 30 meters away. The water carrier provided an estimate of 10 trips per day with a 20-liter container. The daily flow is 200 liters. (Worksheet A, Line 5.)

Building 6 is a residence and water is hand-carried from a standpipe 20 meters away. The water carrier provided no information. There are three persons living in the dwelling. Using Table 1, Western Pacific, the estimate flow is 285 liters per day. (Worksheet A, Line 6.)

The total daily flow for the community is the sum of Lines 1, 2, 3, 4, 5, and 6. The total is 3253 liters per day.

Other Factors in Making Estimates

Data from Nearby Communities. Other communities in the area may have already installed on-site or community sewage disposal systems similar to the types under consideration. Study their successes and failures and apply the data, if applicable, to your situation.

Groundwater Seepage into Sewer. While this is not a subject for the survey, it will affect the total community sewage estimates when used to determine the size of stabilization ponds. Groundwater seepage into a well-constructed sewer system probably will be 84-210 liters per centimeter of pipe diameter per kilometer of pipe length per day. If the sewer pipes are in normally dry soil, use the lesser estimate.

Worksheet A. Sewage Flow Survey Form

	Building Number					
	1	2	3	4	5	6
Building Type						
Residence	☐	☒	☒	☒	☒	☒
Public building	☒	☐	☐	☐	☐	☐
Communal latrine	☐	☐	☐	☐	☐	☐
Source of Water						
Piped	☒	☒	☒	☒	☐	☐
Hand-carried	☐	☐	☐	☐	☒	☒
	If water is piped:					
Water Meter						
No	☐	☒	☒	☒	☐	☐
Yes	☒	☐	☐	☐	☐	☐
If yes, estimated flow from meter reading is:	4,000 liters	___	___	___	___	___ (Line 1)
	If water is piped (no water meter):					
Resident's estimate of daily water use for dwelling or building. Estimate is:	☐	☒	☐	☐	☐	☐
	___	450 liters	___	___	___	___ (Line 2)
Resident's estimate of number of times each fixture used per day. Estimate is:	☐	☐	☒	☐	☐	☐
Pour-flush latrine	___	___	18	___	___	___
Tank-flush latrine	___	___	___	___	___	___
Wash basin	___	___	12	___	___	___
Shower	___	___	3	___	___	___
Kitchen sink	___	___	3	___	___	___
Laundry sink	___	___	1	___	___	___
	Use Table 2 to estimate the total flow from a building with fixture-use information:					

Worksheet A. Sewage Flow Survey Form (continued)

	Building Number					
	1	2	3	4	5	6
Estimated total flow from building is:			718 liters			(Line 3)
Resident provided no information:	☐	☐	☐	☒	☐	☐
Use Table 3 and either count or make best estimate of number of persons living in or using building:						
Estimated number of persons is:				2		
Estimated daily flow from building is:				600 liters		(Line 4)
If water is hand-carried:						
Approximate distance carried is:					30m	20m
Water carrier's estimate of daily water use for building served is:	☐	☐	☐	☐	☒	☐
Daily flow to building is:					200 liters	(Line 5)
Water carrier did not provide estimate:	☐	☐	☐	☐	☐	☒
Use Table 1 and either count or estimate number of persons served by water carrier:						
Estimated number of persons in building is:						3
Estimated daily flow from building is:						285 liters (Line 6)
Total flow from each building (Line 1, 2, 3, 4, 5, or 6) is:	1000 + 450 + 718 + 600 + 200 + 285 =					
Total daily flow for community:	3253 liters					

Worksheet A is a sample of a sewage flow survey form that can be modified and used to record information from a community survey.

liters x centimeters diameter x kilometers length = daily seepage.

This seepage must be added to the estimated daily flow for the community.

For example, suppose 10 kilometers of 10 centimeter diameter sewer pipe is laid in normally dry soil:

Then the seepage = 84 x 10 x 10 = 8400 liters per day.

The estimated daily flow for the community must be increased by 8400 liters per day.

Table 4 indicates which of the five methods of estimating sewage and washwater flows is likely to be used for various types of disposal systems.

Table 4. Best Method of Estimating Flow for Different Types of Systems

Disposal System	Method				
	On-site Measurement	On-site Estimating	Water Meter Estimates	Community Water Use Data	Survey Estimating
Soakage Pits and Trenches	X	X			
Septic Tanks	X	X	X		
Absorption Systems	X	X	X		
Cesspools	X	X	X		
Sewer Systems	X	X	X	X	X
Stabilization Ponds	X	X	X	X	X
Nonconventional Systems	X	X	X		

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.

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